Space Weather Technical Forecast

Issued on Saturday, 16 April 2022 at 13:08 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Further M-class flares likely. Increasing but still slight chance of X-class flares. Slight chance of G1/Minor geomagnetic storms on Days 1 to 3 (16-18 Apr). Chance of Active fluence by Days 3 and 4 (18-19 Apr).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Moderate yesterday with a long duration M2.2 flare observed between 15/1052-1427. This originated from just over the northeast limb, where there are one or more regions rotating onto the visible disc. This is likely associated with ex-2975 which gave several flares including an X-flare on the last rotation. There are three further sunspot regions on the visible disc, all of which are small and simple. No Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR and ACE at L1, showed evidence of a HSS connection to CH74/+. Solar wind speeds were elevated to strong, varying between around 500 km/s to near 700 km/s. The density was mainly average to below average. The interplanetary magnetic field (IMF) strength, Bt, was weak to moderate, peaking at 12nT around 15/1340 UTC. The north-south component, Bz, initially varied moderately between +/-9 nT, but since 15/2000 UTC has been mainly northward directed. The phi angle has been mostly positive (away from the Sun). Geomagnetic activity has been Quiet to Active through this period.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) measured at GOES-16 at GEO was at background levels. The high energy electron flux (greater than 2 MeV) was at normal background to moderate levels, peaking at 641 pfu at 15/1600 UTC. The associated 24 hour electron fluence has been below the Active threshold throughout, on a brief rising trend, with observed fluence of 2.13e7 integrated pfu at 16/0000 UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is expected to be Low to Moderate. The new region(s) rotating onto the northeast limb appear active, with a recent M-flare and CME activity. The risk of M-flares is expected to increase as these regions rotate fully onto the visible disc, with a slight chance of X-flares.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs are currently expected. Earth has connected with the HSS from CH74, with a further HSS from CH75 expected within the next 24 hours. However, it seems likely that these two features will run together, allowing elevated to strong solar wind speeds through much of Days 1-3 (16-18 Apr), before declining through Day 4 (19 Apr). This is also a positive polarity coronal hole which tends to give a muted geomagnetic response during spring.
Geomagnetic activity is forecast to be mostly Quiet to Active with just a slight chance of an isolated G1/Minor Storm interval during Days 1-3. Activity is expected to be largely Quiet by Day 4.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is

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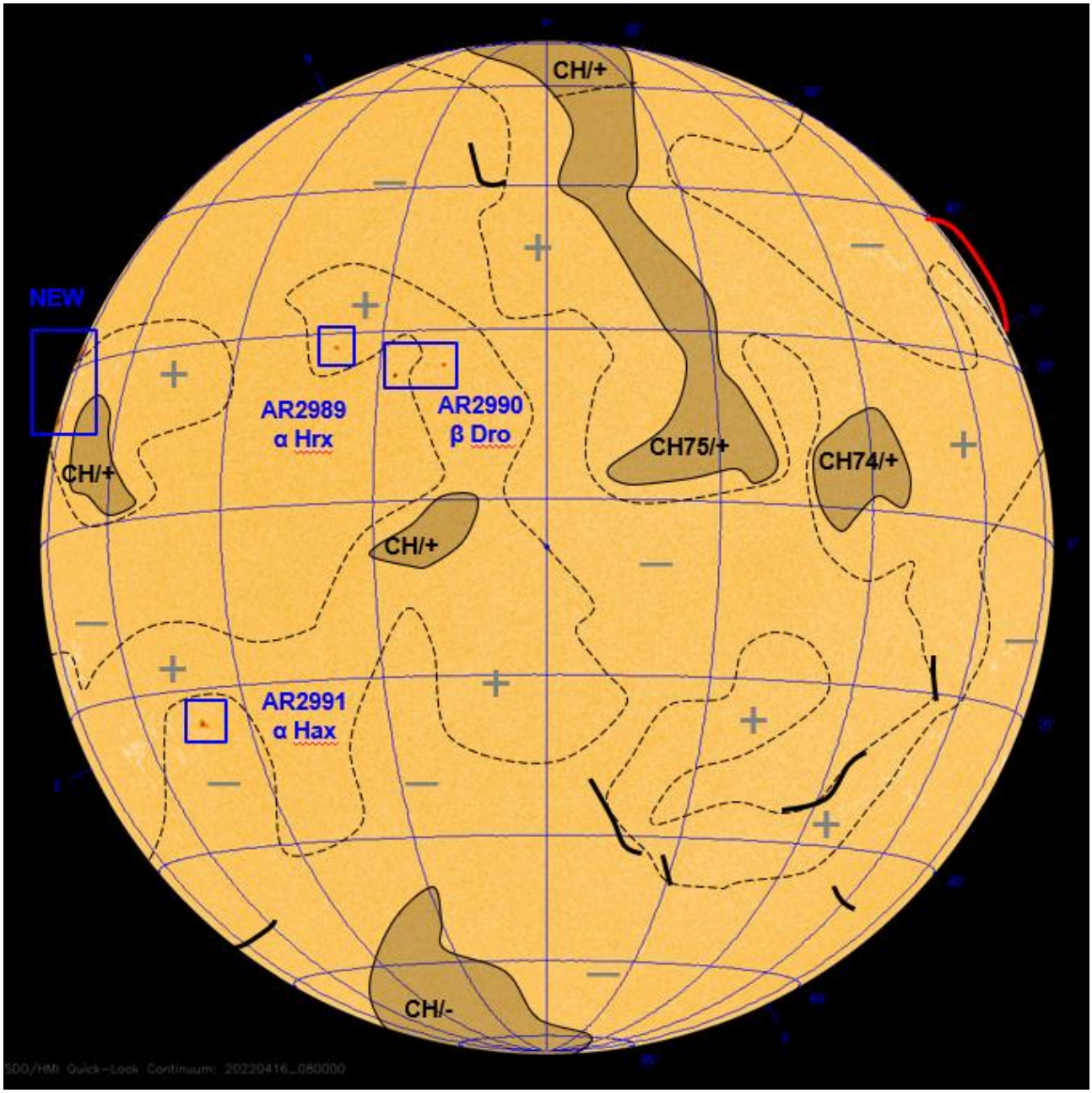
expected to be at background levels, with just a slight increase in probability by the end of the period as the new region(s) rotating on move westwards. High energy electron flux (greater than 2 MeV) is likely to reach Moderate levels, perhaps peaking at high levels at the diurnal maximum each day. The associated 24 hour electron fluence is likely to remain below the Active (1e8 integrated pfu) threshold, but on a rising trend, with a chance of reaching Active by Days 3 and 4 (18-19 Apr).

Figure 1. Solar Analysis Valid 16/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

No Earth directed CMEs are currently expected. Earth has connected with the High Speed Stream from CH74, which has resulted in elevated to strong solar wind speeds. Solar wind speeds may decline at first on Day 1 (16 Apr) before a further enhancement from the arrival of the fast wind of CH75/+ is forecast on Day 2 (17-18 Apr). However, it seems likely that these two features will run together, allowing elevated to strong solar wind speeds through much of Days 1-3, before likely declining through Day 4 (19 Apr). The timing and strength of this feature is lower confidence, with these features new to this rotation making persistence of little value, and a lack of data from STEREO-A. Furthermore, this is a positive coronal hole which tends to give a muted geomagnetic response during spring.

Geomagnetic activity is forecast to be mostly Quiet to Active with just a slight chance of an isolated G1/Minor Storm interval during Days 1-3. Activity is expected to be largely Quiet by Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	10	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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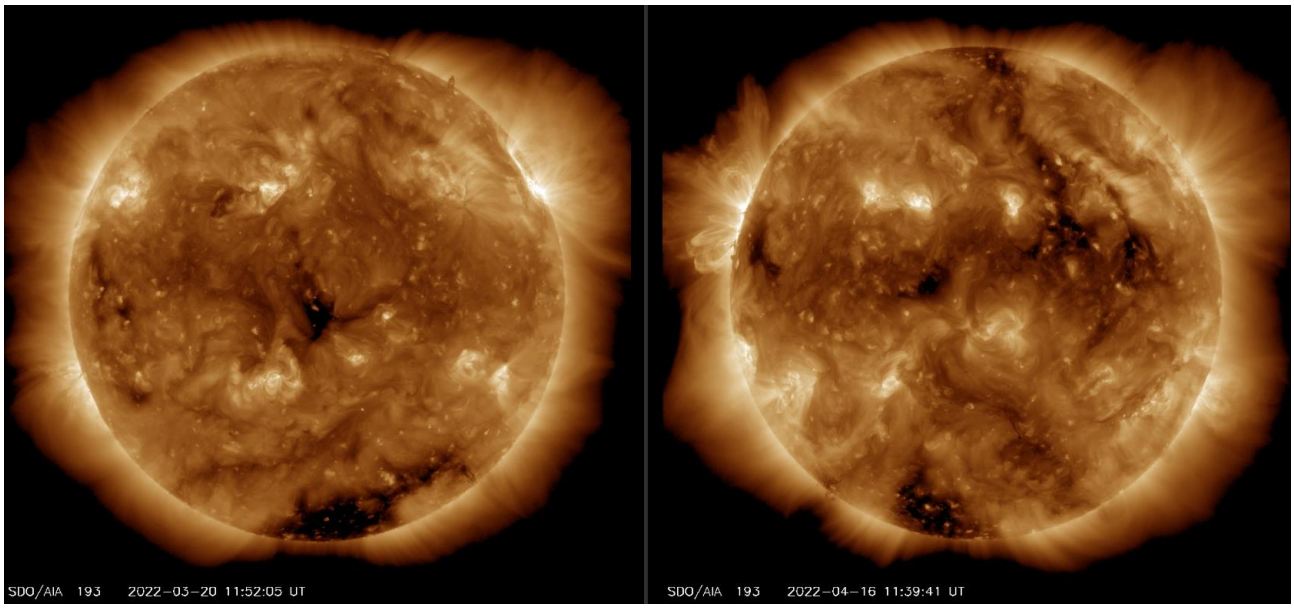
Figure 2: AIA-193 images from last rotation (left) and this rotation (right) showing the differences in coronal holes between this rotation and last. This reduces the usefulness of persistence forecasting for these features.



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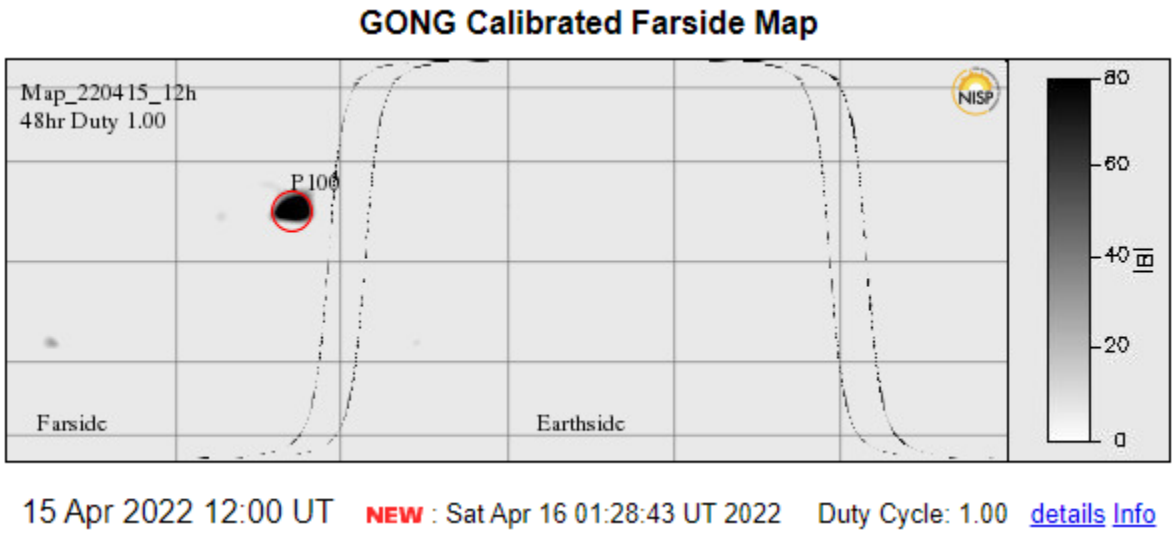
Radio Blackouts - X-Ray Flares:
Solar activity is expected to be Low to Moderate. The long duration M flare on the 15th was from a region (or regions) just over the northeast limb which are now in the process of rotating onto the visible disc. It may be, or is close to, Ex-2975 which was active on the last rotation producing 40 C-class flares, 7 M-class flares and one X-flare.

There are three other sunspot regions on the disc. These are all small and simple regions - AR2990 Dro/Beta and AR2989 Hrx/Alpha both in the northeast and AR2991 Hax/Alpha in the southeast.

The new region(s) rotating on appear active with recent CMEs observed, and a notable signature on far-sided products, including helioseismographs and the GONG far-side magnetograph. This corresponds to the area around Ex-2975 which has been traversing across the far-side, and matches to a bright area of flux on visible on the STEREO A EUVI-imagery. These far-side regions have led to background x-ray flux reaching C-class levels. Solar activity activity is therefore likely to increase this forecast period as these region(s) rotate fully onto the disc, with an increase in probabilities reflecting this trend.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	60	70	70
Very Active	R3 to R5 X Class	No	5	10	10	10

Figure 3:GONG farside map showing the presence of an active sunspot region near the northeast limb.



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and likely to remain so through the next 4 days. However, the new region(s) rotating onto the northeast limb are likely associated with ex-2975 which had a history on the previous rotation of giving several S1/Minor radiation storms. As such, there is just a slight increase in the probability of S1 towards the end of the period as these regions move westwards.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	2
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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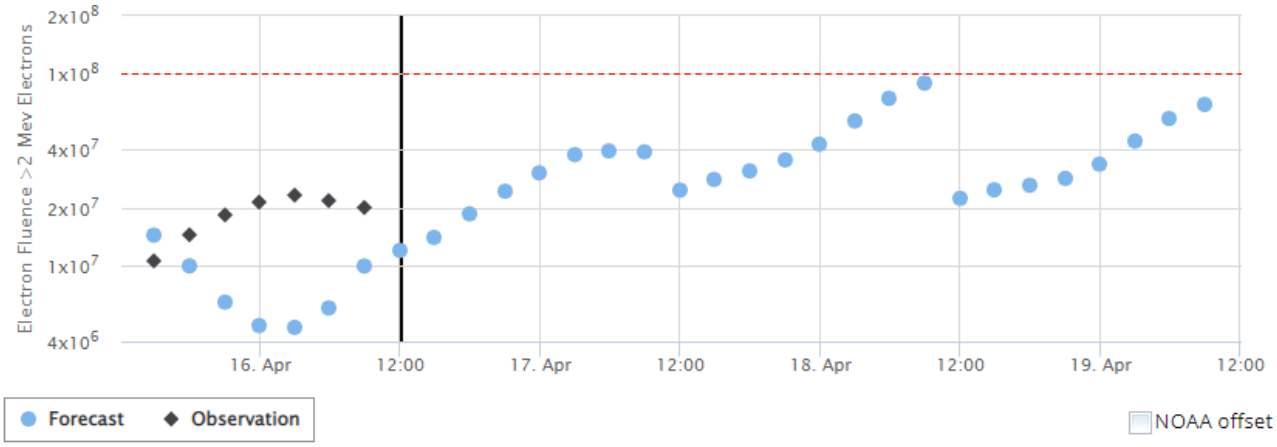
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as observed by GOES-16 at GEO reached moderate levels at yesterday's diurnal peak. This is likely to be on a slight rising trend with the current HSS perhaps causing some electron charging. However, the positive polarity of the coronal hole means that any geomagnetic response is likely to be muted, and charging may well be limited as a consequence. As such, electron flux is expected to reach moderate levels at the diurnal peak in the coming days, but may just reach high levels.

The associated 24 hour electron fluence is likely to remain below the Active threshold, but on a rising trend, with a chance of reaching Active by Days 3 and 4 (18-19 Apr). REFM is now also suggesting a rising trend peaking near Active which currently seems like reasonable guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	10	30	40
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM model showing a rising trend just below the Active threshold, which currently seems like reasonable guidance.



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